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AUTHOR Blanchard, Harry E.; Brewer, William F.
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ABSTRACT

Two experiments were conducted to test the hypothesis that readers make inferences if those inferences are necessary for the reconstruction of the writer's model. Each experiment involved the same 42 subjects who read a series of short passages. The first experiment examined inferences pertaining either to the underlying global situation of a passage or to local events within it, while the second differentiated between local inferences required for reconstruction of the writer's mental model and those not required. In each experiment, subjects first read a passage, then several test sentences, some of which tested information that was presented (explicit) and some of which tested information not presented in the passage. The subjects had to decide, as quickly and accurately as possible, if the sentence was consistent with information in the passage. Interaction between explicit/implicit presentation and inference type indicated that readers do, indeed, make inferences if the inferences are necessary for the reconstruction of the writer's mental model. (A sample passage and its test questions are appended.) (FL)

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Inferences and the Construction of Mental Models in Reading Comprehension

Harry E. Blanchard and William F. Brewer

Department of Psychology

and

Center for the Study of Reading

University of Illinois at Urbana-Champaign

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Paper presented at the annual meeting of the Midwestern Psychological Association, Chicago, May, 1983.

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Abstract

Subjects read short passages and verified sentences which were explicitly stated in the passage or left to be inferenced. Interaction between explicit-inexplicit presentation and inference type indicated that inferences are made if they are necessary for reconstruction of the writer's mental model.

Written text includes only part of the information required for comprehension. Therefore, an important part of the comprehension process is the generation of inferences to fill in unstated information. I am speaking here of what Brewer (1977) has called pragmatic inferences: inferences which are not logically required but do follow from a reader's knowledge of the world and events. However, there are an unlimited number of inferences which could be made in the process of comprehension. There must be some mechanism for controlling inferences (Goetz, 1979; Schank, 1979). Various solutions to this problem of constraining inferences have been proposed. For example, Schank (1979) proposed that inferences are made if they are interesting, Goetz (1979) proposed that inferences are made if they are important in the structure of the text, and Corbett and Dosher (1978) proposed that inferences are made if they are highly probable.

We believe that the problem of constraining inferences can at least partly be solved by using the concept of a mental model, as advanced by Johnson-Laird (1981). Comprehension is the process of constructing a mental model. A mental model is a rich analogical representation generated from a propositional structure; it is a specific instantiation of the meaning of a passage. The mental model is related to mental imagery: images are mental models but not all mental models are images. In order to understand a passage correctly, the reader must reconstruct the mental model that the writer was attempting to express in the text. Two or more mental models are possible if a passage is ambiguous. A

mental model cannot be constructed if a passage is incomprehensible. We hypothesized that inferences are made if they are necessary for the reader to reconstruct the writer's mental model. In this view, high level inferences are not separate acts of generating missing propositions, but are part of the process of constructing the mental model.

Experiment 1

Our initial hypothesis was that inferences relating to the global situation underlying the passage would be necessary for developing a mental model, while those which pertain to only part of the passage would not. Consequently, Experiment 1 examined these two types of inferences: global inferences (see the sample passage and inferences on the handout) and local inferences (labelled as local type 2 on the handout). A rating study was carried out to empirically select the two types of inferences. The rating subjects were given passages to read followed by questions based on possible inferences. In the questions, the subjects were asked to rate how well they would understand the passage if the candidate inference was denied. For example, with the global inference of the sample passage, the rating subjects were asked "How well would you now understand the passage if you were told that Sally and Fred were not going to see a movie?" For an adequate global inference, it would be impossible to deny the inference in this way and still construct a coherent mental model, so subjects would rate their understanding very low. But

for local inferences, a coherent mental model would be quite possible if the inference is denied, so subjects would rate their understanding as high as they would if the inference had not been denied In addition, in order to equate the global and local inferences on their probability of occurrence in the mental model, subjects were also asked to rate how likely the event expressed by the inference was to have happened.

The inferences chosen using this rating technique were presented as stimuli in a comprehension study. Forty-two subjects read five short passages like the sample passage shown in the handout. After each passage the subjects saw several test sentences. Some sentences tested information that was in the passage (explicit condition) and some sentences tested information that was not presented in the passage (inexplicit condition). Subjects had to decide if the test sentence was consistent with the information in the passage, as quickly and accurately as possible, and their reaction times were collected.

The logic of this design is as follows. The RTs for verification of sentences explicitly stated in the text were compared to RTs for those same sentences when they were left implied by the text. If the inference expressed by the sentence was typically made when subjects were comprehending the passage, RTs for the explicit and inexplicit conditions should not differ. That is, the proposition corresponding to the sentence would have been processed and stored regardless of whether it was explicitly

given or generated as an inference. If the inference was not typically made while subjects were comprehending the passage, the RT should be longer when the sentence was left implied in the passage. The longer latency would reflect the processing time needed to make the inference at the time the subject is tested.

However, the RTs for the inferences in the explicit and inexplicit conditions cannot be compared directly, for this leaves contaminating effects due to verbatim memory and/or priming (Ratcliff & McKoon, 1978) uncontrolled. Other inference studies using RTs in this way have not dealt with this problem. In order to avoid this type of artifact, we compared the differences between the inexplicit and explicit conditions of the two types of inferences rather than comparing the types directly. If the hypothesis that global inferences are made is correct, then the difference between the explicit and inexplicit RTs for global inferences should be smaller than the difference in RTs for local inferences. In analysis of variance terms, our hypothesis predicts an interaction between presentation condition (explicit vs. inexplicit) and inference type (global vs. local).

The results of Experiment 1 confirmed our hypothesis: Figure 1 shows the significant interaction between presentation condition and inference type. The global inferences, inferences which are required to reconstruct the writer's mental model, were apparently made during reading much more often than were the local inferences. Furthermore, since the global and local

inferences were equated on the basis of probability, it is clear that inferences are not made if they are simply highly probable.

Experiment 2

In Experiment 1, inferences which pertained to the underlying global situation were compared to inferences which pertained to local events. However, some inferences which pertained to only part of a passage may still be necessary for the reader to reconstruct the writer's mental model. So, in Experiment 2, local inferences were differentiated into those required for reconstruction of the writer's mental model (exemplified by the inference labelled as local type 1 in the handout) and those not required for the mental model (labelled as local type 2 in the handout). The local type 2 inferences were details about some local aspect of the situation described by the passage, but these were details that were not necessary to understand all or part of the situation described. Local type 1 inferences also dealt with only part of the situation described by the passage, but they were necessary in order to construct a mental model of the events of some part of the passage. Note, though, that both types of inferences are just as probable; they were matched on probability ratings. A new rating question was also included in order to differentiate the local type 1 inferences from the other two types. In this question, subjects were asked how well they would understand the relevant part of the passage if the inference were denied. Low ratings of

understanding were diagnostic of local type 1 inferences. The design and procedure of the comprehension experiment was the same as in Experiment 1, except, of course, for the addition of the new type of inference.

According to our hypothesis, there should be no interaction between global and local type 1 inferences, since both types should be made at comprehension. There should be an interaction between global and local type 2 inferences (replicating Experiment 1) and between local type 1 and local type 2 inferences, since local type 2 inferences must be made at test time. As can be seen in Figure 2, the predictions were again confirmed: there was no interaction for global and local type 1 inferences, but interactions did occur for the other two cases.

Conclusion

The data presented are consistent with our mental model approach to inferences in the comprehension of text: inferences are made if they are necessary to reconstruct the writer's mental model. We have at least partly solved the problem of constraining inferences. Furthermore, this mental model approach is more successful than other proposals. For instance, Schank's (1979) idea that inferences are made if they are interesting, first, does not solve the problem, since there are an unlimited number of interesting inferences, and, second, is directly contradicted by our findings, for the inferences made by our subjects were not particularly interesting (at least not any more

interesting than the inferences that were not made). Similarly, the idea that inferences are automatically made if they are highly probable was contradicted by our data, for all the inferences, global, local type 1, and local type 2, were matched on probability, yet the local type 2 inferences were not being made by the readers, at least not very frequently.

It should also be noted that our findings bear on another related problem in the inference literature: the question of whether inferences are made at the time of comprehension or afterwards, at the time of test or recall. It is clear that inferences can be made at both points in time. Those inferences involved in the construction of a mental model are generated at comprehension. However, <u>any</u> inference about the text can be made at test time, if the demands of the task require that it be made (as the demands of our task required the local type 2 inferences to be made at test, so increasing the RT).

References

Brewer, W. F. Memory for the pragmatic implications of sentences. Memory and Cognition, 1977, 5, 673-678.

Corbett, A. T., & Dosher, B. A. Instrument inferences in sentence encoding. Journal of Verbal Learning and Verbal Behavior, 1978, 17, 479-491.

Goetz, E. T. Inferring from text: Some factors influencing which inferences will be made. Discourse Processes, 1979, 2, 179-195.

Johnson-Laird, P. N. Mental models in cognitive science. In D. A. Norman (Eds.), Perspectives on cognitive science. Norwood, N.J.: Ablex Publishing Corporation, 1981.

Ratcliff, R., & McKoon, G. Priming in item recognition. Journal of Verbal Learning and Verbal Behavior, 1978, 17, 403-417.

Schank, R. C. Interestingness: Controlling inferences. Artificial Intelligence, 1979, 12, 273-297.

Harry E. Blanchard & William F. Brewer
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Sample Passage

Fred and Sally decided to go out together Friday night. They drove down to the city and walked downtown. When they reached the ticket office, Fred got into line to buy tickets. Sally noticed one earring was missing. Then she saw her earring on the floor and picked it up. When Fred reached the window he asked the woman there for two adult tickets. The tickets popped out of a little slot in front of him as the woman typed a few keys on the cash register. Fred handed over a bill and the woman gave him some change. Then, Sally and Fred walked inside. Sally got some buttered popcorn at the concession stand. They walked into the dark theater and sat down together. In a few minutes sound filled the room and pictures covered the screen in front of them.

Inference types and corresponding test sentences:

1. Global

   Required for the construction of a mental model
   Pertains to entire passage

   Sally and Fred were going to see a movie.

2. Local Type 1

   Required for the construction of a mental model
   Pertains to part of the passage

   Sally's earring had fallen to the floor.

3. Local Type 2

   Not required for a mental model

   The seats had to be folded down.

Figure 1.

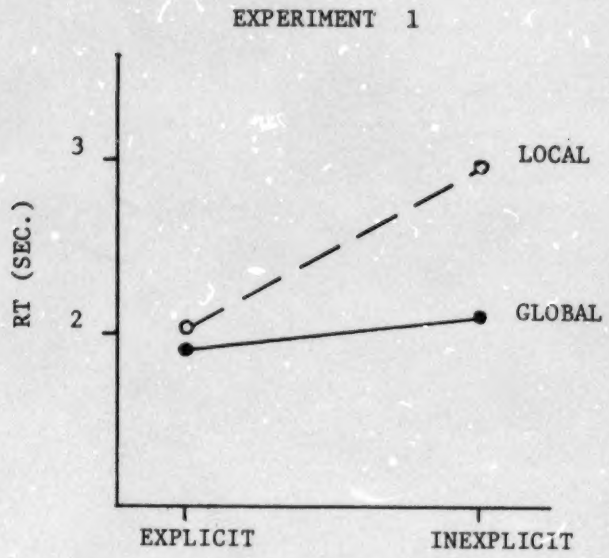

Figure 2.